

Interactive Visualisation of a Volume Rendered Virtual Colonoscopy Using a Desktop Personal Computer

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Colorectal cancer is the second most common cause of cancer deaths in industrialised societies. Early detection relies on population screening and significantly increases the chances of survival. Virtual colonoscopy (VC) is a minimally invasive screening technique for colorectal cancer. VC via volume rendering is more sensitive and specific than VC via surface rendering. Hitherto, the computational resources required for volume rendering have restricted its interactive use to high-end workstations. Volume rendering produces superior results because it uses a transition layer from lumen to the colon wall instead of a single surface value. We have developed a fast three-stage method for volume rendering VC. In the first stage the lumen boundary is identified and using a thickening technique a layer from lumen to the colon wall is then extracted. In the second stage we further reduce the time to render each frame by use of a visibility determination technique. In this we divide the colon into consecutive sections based on the curvature of the colon and when the image plane is inside one section, only those sections visible from that section are considered. For maximum efficiency these two stages are performed once in a pre-processing step. The third stage is an object order volume rendering using the potentially visible voxels belonging to the extracted layer. Shear-warp factorisation provides efficient access to these voxels.

Results were obtained using a synthetic colon on a desktop personal computer (PC). Pre-processing to extract the colon wall and to determine the visibility took 50 secs. The first stage of the method removed approximately 95% of the data and the visibility determination stage eliminated a further 70%. Visualisation of each frame of the VC required approximately 1.5% of the original data set. This was rendered at 5 frames per second, which would enable a clinician to interactively navigate the virtual colon on a desktop PC.

Keywords: volume-rendering, virtual colonoscopy, visualisation